

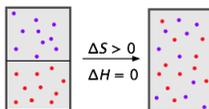
8.2.2A: Solutions of Gaseous Solutes in Gaseous Solvents

Learning Objectives

Make sure you thoroughly understand the following essential ideas:

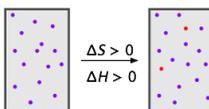
- Why are gases the only state of matter that never fail to form solutions?

Mixtures of gases are really solutions, but we tend not to think of them this way because they mix together freely and with no limits to their compositions; we say that gases are *miscible in all proportions*.



To the extent that gases behave ideally (because they consist mostly of empty space), their mixing does not involve energy changes at all; the mixing of gases is driven entirely by the increase in entropy (S) as each kind of molecule occupies and shares the space and kinetic energy of the other. Your nose can be a remarkably sensitive instrument for detecting components of gaseous solutions, even at the parts-per-million level. The olfactory experiences resulting from cooking cabbage, eating asparagus, and bodily emanations that are not mentionable in polite society are well known.

Can solids or liquids "dissolve" in a gaseous solvent? In a very narrow sense they can, but only to a very small extent. Dissolution of a condensed phase of matter into a gas is formally equivalent to evaporation (of a liquid) or sublimation (of a solid), so the process really amounts to the mixing of gases.



The energy required to remove molecules from their neighbors in a liquid or solid and into the gaseous phase is generally too great to be compensated by the greater entropy they enjoy in the larger volume of the mixture, so solids tend to have relatively low vapor pressures. The same is true of liquids at temperatures well below their boiling points. These two cases of gaseous solutions can be summarized as follows:

gaseous solvent, solute →	gas	liquid
energy to disperse solute	nil	large
energy to introduce into gas	nil	large
increase in entropy	large	small
miscibility	complete	very limited

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